

## Diachronous deposits of Lake Pannon in the Kisalföld Basin reflect basin and mollusc evolution

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*Pannonischer See*  
*Kleine Ungarische Tiefebene*  
*Burgenland*  
*Slowakei*  
*Beckenanalyse*  
*Mollusken-Evolution*

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### Diachrone Ablagerungen des Pannonischen Sees in der Kleinen Ungarischen Tiefebene als Zeugen der Beckenentwicklung und der Molluskenevolution

#### Zusammenfassung

Das jungtertiäre Becken der Kleinen Ungarischen Tiefebene (Kisalföld) bildet einen Teilabschnitt des mitteleuropäischen Pannonischen Beckens und umfaßt Gebiete in der südwestlichen Slowakei, im östlichen Österreich sowie im nordwestlichen Ungarn. Littorale Sedimente des spätmiocänen Pannonischen Sees sind sowohl an dessen Westrand im Burgenland aufgeschlossen, als auch an dessen Ostrand im Transdanubischen Mittelgebirge. Reflexionsseismische Profile bezeugen, daß die Sedimentfüllung der Kleinen Ungarischen Tiefebene von NW nach SE progradierte. Als Folge dessen stellen die littoralen Sedimente des Burgenlands und des Transdanubischen Mittelgebirges nicht gegenüberliegende Küstenbildungen der Kleinen Ungarischen Tiefebene dar, sondern wurden entlang der gleichen progradierten nordwestlichen Küstenlinie des Pannonischen Sees, jedoch zu jeweils anderer Zeit, abgelagert. Die Molluskenfauna der westlichen Aufschlüsse ist einformig ausgebildet und wird hier als "Fauna des Burgenlands" bezeichnet. Gleichermaßen ist auch die Fauna der östlichen Aufschlüsse recht einformig ausgebildet und wird hier als "Fauna des Transdanubischen Mittelgebirges" bezeichnet. Aufgrund der Ähnlichkeiten zwischen diesen beiden Faunen, kann wohl davon ausgegangen werden, daß ihre Lebensräume im littoralen Bereich des Pannonischen Sees sehr ähnlich ausgebildet waren. Mehrere Bivalvenarten zeigen jedoch deutliche morphologische Unterschiede in den beiden Faunengebieten, die auf evolutive Ursachen zurückgeführt werden. Der Unterschied zwischen der Fauna des Burgenlands und der Fauna des Transdanubischen Mittelgebirges hat biostratigraphische Bedeutung, wodurch die Grenze zwischen der *Lymnocardium conjungens* Zone (Burgenland) und der *Lymnocardium ponticum* Zone (Transdanubisches Mittelgebirge) definiert wird. Magnetostratigraphische Daten legen nahe, daß mit einem Zeitunterschied im Bereich von etwa 500.000 Jahren zu rechnen sein dürfte.

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## Abstract

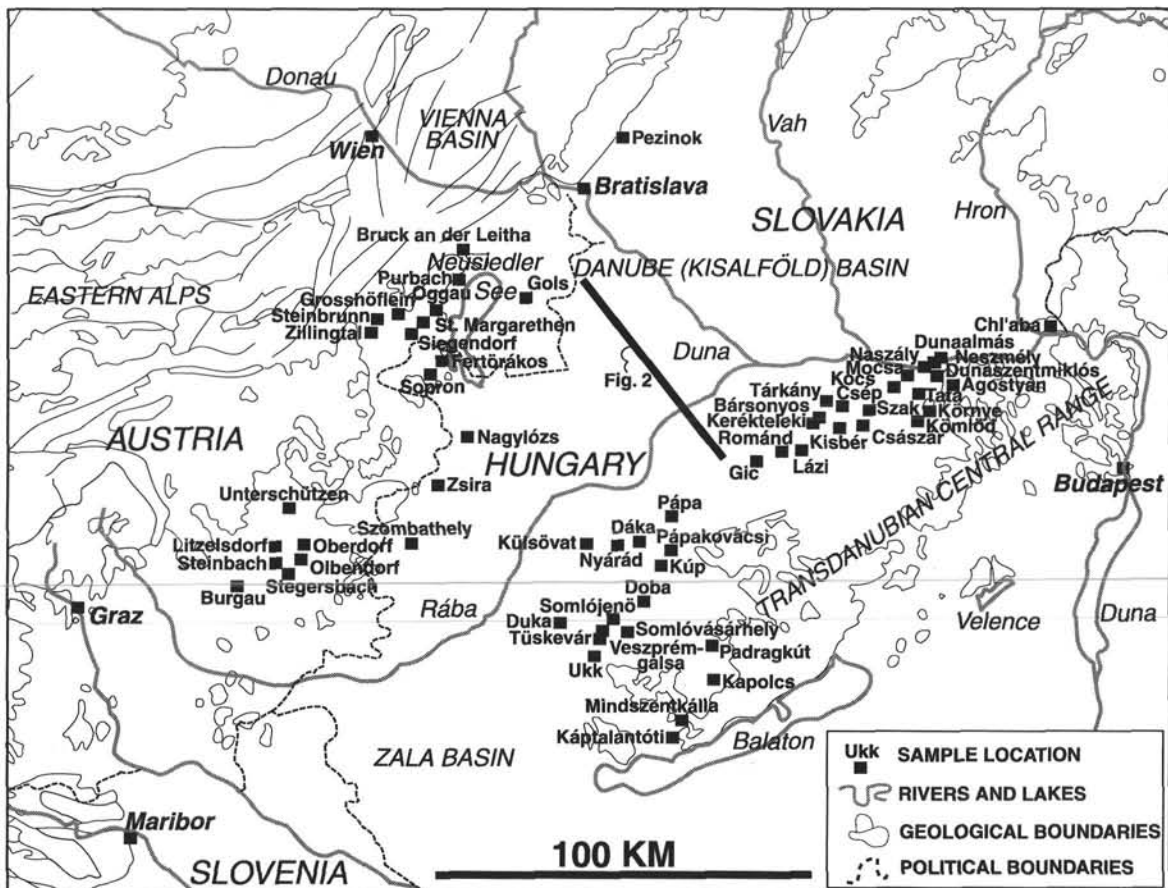
The Neogene Kisalföld Basin is a subunit of the Central European Pannonian Basin. It includes southwestern Slovakia, the easternmost part of Austria, and northwestern Hungary. Littoral sediments of the Late Miocene Lake Pannon outcrop along the western (Burgenland) and eastern (Transdanubian Central Range, TCR) margins of the basin. Seismic reflection profiles across the Kisalföld Basin indicate that the basin was filled with sediments via progradation from the NW to the SE. Consequently, the littoral sediments of Burgenland and the Transdanubian Central Range do not represent opposite shores of the Kisalföld Basin; instead, they were deposited on the same prograding northwestern shoreline of Lake Pannon during two different time intervals. The mollusc fauna of the western outcrops is uniform (referred to here as the Burgenland fauna). Similarly, the eastern outcrops yield a uniform fauna (the TCR fauna). Similarity between the Burgenland and the TCR faunas allows us to establish that they lived in similar environments in the littoral zone of Lake Pannon. There are, however, consistent morphological differences between Burgenland and TCR forms in several bivalve species, which are thus interpreted as evolutionary change. The difference between the Burgenland and TCR faunas is useful for biostratigraphy; it defines the boundary between the *Lymnocardium conjungens* Zone (Burgenland) and *Lymnocardium ponticum* Zone (TCR). Magnetostratigraphic data suggest that the time difference involved is on the order of a half million years.

## 1. Geological setting

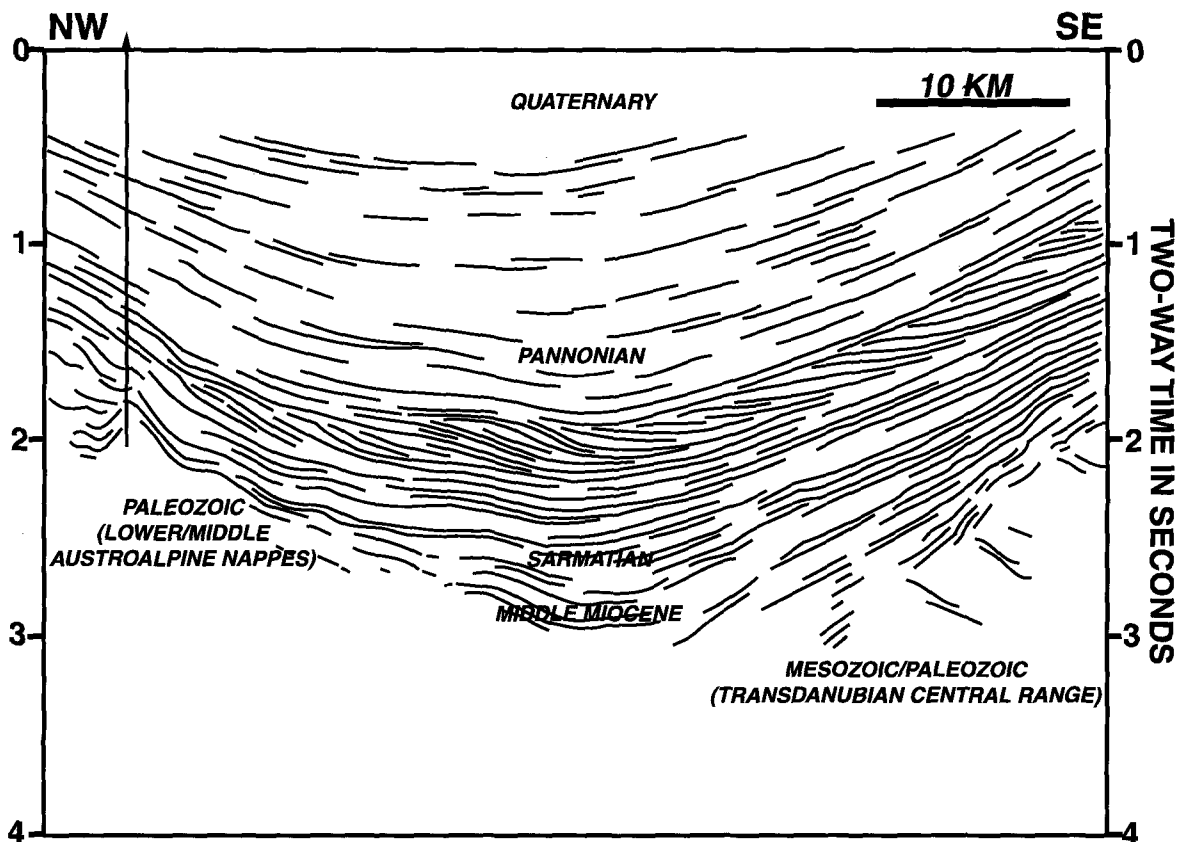
The Kisalföld ("Danube") Basin is a subbasin of the Neogene Pannonian Basin of Central Europe. Its area is shared by Austria, Slovakia, and Hungary (Text-Fig.1). The geology of the Kisalföld basin has recently been treated by KÓROSSY (1987), KEITH et al. (1994), TARI (1994, 1996), HORVÁTH et al. (1995a), MATTICK et al. (1996), HRUŠECKÝ et al. (1996), and KOVÁČ & BARÁTH (1996). The Kisalföld Neogene Basin is superimposed on the Alpine thrust-fold belts of the Eastern Alps and Western Carpathians. Following an Early to Middle Miocene, partly terrestrial, partly marine synrift stage, the bulk of the Neogene sedimentary formations were deposited in the Late Miocene brackish Lake Pannon, which flooded the area due to a widespread post-rift (thermal) subsidence. Seismic reflectors show that the Kisalföld Basin was filled with sediments prevailing from the NW, implying that

the littoral zone of Lake Pannon shifted from the NW towards the SE (Text-Fig. 2). Seismic profiles also suggest that at this time the Transdanubian Central Range (TCR) was a submerged sill, or a series of islands at best.

Due to Pliocene-Quaternary tectonic inversion, the sedimentary formations of Lake Pannon became exposed and eroded along the western and eastern edges of the basin, while the central part underwent continued subsidence, and was covered by Pliocene and Quaternary terrestrial sediments (HORVÁTH et al., 1995b). Along the western edge of the basin, the littoral sediments of Lake Pannon outcrop in a number of fossiliferous localities in Burgenland and adjacent areas of Slovakia and Hungary, from Pezinok in the north to Stegersbach in the south. Similar sediments outcrop at the eastern boundary of the basin, along the western foot of the TCR, from Chl'aba in the north to Ukk in the south (Text-Fig. 1).



Text-Fig. 1.  
The Kisalföld Basin with locations referred to in the text and in the Appendix.



Text-Fig. 2.  
Line drawing interpretation of a seismic profile illustrating progradation from the northwest towards the south-east across the Kisalföld Basin. For location see Fig. 1. Vertical exaggeration is ten-fold at 2000 m/s velocity. For the original seismic profile see TARI (1994) and HORVÁTH et al. (1995b).

We observed that the littoral bivalve fauna from the western margin of the basin ("Burgenland fauna") is uniform in the sense that it represents a particular evolutionary stage in each lineage. We found that the same is true for the eastern margin as well; apart from slight facies differences, any member of this "TCR fauna" is represented by the same evolutionary stage in the outcrops throughout the entire length of the TCR. There are striking similarities between these uniform western and eastern faunas, suggesting that their paleoenvironments were very similar. In a number of bivalve species, however, there are relatively slight, but consistent morphological differences between the two faunas, reflecting evolutionary changes through time. These differences in most cases are easily recognizable, and make the two faunas distinguishable.

## 2. Materials and methods

In this study, we included only fossils that we have seen ourselves or that were depicted in publications. We did not use reports or determinations that we have not had the opportunity to check. We utilized the following museum and private collections (the list of fossils that formed the basis for this study is given in the Appendix):

- BL: Collection of the Burgenland Museum (Eisenstadt, Austria)
- DHG: Collection of DANA H. GEARY (Madison, USA) (Stegersbach material is courtesy of FRANZ SAUERZOPF)
- FS: Collection of Franz Sauerzopf (Rust, Austria)
- HPM: Collection of the Croatian Natural History Museum (Zagreb, Croatia)

- JPL: Collection of JOSEF PAUL LUEGER (St. Leonhard am Forst, Austria)
- MÁFI: Collection of the Hungarian Geological Institute (Budapest, Hungary)
- MM: Collection of PÁL MÜLLER and IMRE MAGYAR (Budapest, Hungary)
- NHMW: Collection of the Vienna Natural History Museum (Vienna, Austria)
- TTM: Collection of the Hungarian Natural History Museum (Budapest, Hungary)
- UV: Collection of the University of Vienna (Vienna, Austria)

The fossils were collected from littoral sandy or gravelly deposits. Even in the case of museum specimens, we were able to identify the original embedding rock because we knew the outcrop from which the specimens came, the description of the outcrop was available, or because sand grains attached to the shells indicated the sandy environment. These sand layers are either amalgamated, forming thick sandy sequences, or they are thin intercalations in sublittoral silt sequences.

In Burgenland as well as adjacent areas of Slovakia and Hungary, the littoral deposits of Lake Pannon are of various ages. In this study we included the youngest and most widespread littoral deposits only, omitting older formations (*Congeria ornithopsis* and *Congeria hoernesii* Zones, or B and C Zones of PAPP, 1951) which outcrop in more restricted areas (e. g. in several localities around Sopron [PAPP, 1951, VITÁLIS, 1951], and in the Styrian Basin [EBNER & SACHSENHOFER, 1995]). These older formations are missing at the eastern margin of the basin.

Our objective here is not to compile a comprehensive list of bivalve species for each locality; instead, we want to com-

plete earlier published information with unpublished data coming from different collections, in order to demonstrate similarities and differences among bivalve faunas. We omitted some relatively rare, or less studied dreissenid and cardiid species, and the sporadically appearing *Pisidium*. On the other hand, we included species that rarely occur in the given fauna if they are common on the opposite side of the basin (e. g. *Congeria unguilacaprae* is common in the TCR fauna, so we included its occurrences in Sopron and Pezinok; or "*Didacna*" *deserta* is very common in the Burgenland fauna, so we included its single known occurrence in the TCR area).

### 3. Comparison of the Burgenland and TCR faunas

#### 3.1 Similarities

Many identical or very closely related species occur in the Burgenland and TCR faunas. Some of these common species are rare in other parts of the Pannonian basin, thus enhancing the impression that the Burgenland and TCR faunas are closely related. Some of our new findings confirm a close relationship between the two faunas: we found *Euxinocardium schreteri*, a species that had been known from the TCR only, in Burgenland. We also found two "typical" Burgenland species, *Lymnocardium tucani* and "*Monodacna*" *viennensis*, in the TCR.

Species that occur in both faunas include: *Congeria unguilacaprae*, *Dreissena bipartita*, *Lymnocardium hantkeni*, *L. tucani*, *Caladacna steindachneri*, *Euxinocardium schreteri*, "*Monodacna*" *viennensis*, "*Didacna*" *deserta*, and *Parvidacna* sp. Ancestor – descendant pairs in the two faunas are (with the older, Burgenland form first): *Unio atavus*-*U. mihanovici*, *Congeria gitneri*-*Dreissena auricularis*, *Lymnocardium schedelianum*-*L. variocostatum*, *L. conjungens*-*L. penslii*, and *L. edlaueri*-*L. ponticum*.

#### 3.2. Differences

Some of the differences between the Burgenland fauna and the TCR fauna are conspicuous. The TCR fauna lacks shouldered *Melanopsis* (*M. vindobonensis*, *M. fossilis*), certain large *Congeria* species (*C. pancici*, *C. spathulata*), and some cardiid species (*L. brunense*, *L. danicici*, *L. carnuntinum*, *L. stoosi*), whereas the Burgenland fauna lacks *Dreissenomya unioides*, "*Lymnocardium*" *prisca*, and *L. apertum*. Significant

differences in the frequency of certain species exist as well. "*Didacna*" *deserta* is very common in Burgenland, but we know only a single intact specimen from the TCR. *Congeria unguilacaprae*, on the other hand, is one of the most common species in the TCR, but it is much less common in Burgenland.

Aside from these conspicuous taxonomic differences, slight but consistent morphological differences characterize the ancestor (Burgenland) – descendant (TCR) species pairs in some bivalves. Traditionally, the ancestral and the derived forms were described as different species, although the morphological difference between them is sometimes very slight, and can be appreciated only when larger samples are compared.

In Burgenland specimens of *Unio atavus*, the position of the beak in relation to the anterior margin is variable, but typically quite distant. In its descendant, *U. mihanovici*, however, it is invariably terminal, very close to the anterior margin. In addition, the beak is always above the dorsal margin in *U. atavus*, whereas it is in much lower position in *U. mihanovici* (MÜLLER, 1990; Plate 1, Fig. A, A').

According to PAPP (1950), the Vienna Basin and Burgenland fossil record shows that *Congeria* lost its apophyse (a tiny plate where the adductor muscle attached) in at least two independent lineages. *Congeria* has a well-developed apophyse, whereas the lack of it is a diagnostic feature of *Dreissena*, where both the anterior adductor and retractor attach to the same septum. One of these morphological changes is reflected in the Burgenland/TCR material. *Congeria gitneri* (= "*D. minima*" in LUEGER, 1980) in Stegersbach and Großhöflein (Burgenland) has a rudimentary apophyse (Plate 1, Fig. B, C, D). In *Dreissena auricularis* (TCR), however, there is no trace of the apophyse left (Plate 1, Figs. B', C', D'). (We know a sample from Pezinok [MÁFI Pl. 6091] where there is no apophyse, although this locality yielded Burgenland fauna.)

The Burgenland *Lymnocardium schedelianum* is a large cockle with relatively wide and rounded ribs, which are always separated by intercostal space (Plate 1, Fig. E). The only difference between this form and its descendant from the TCR, *L. variocostatum*, is that the ribs of the latter are completely flat and tightly spaced; intercostal space is present only on the very anterior slope of the shell (Plate 1, Fig. E').

*Lymnocardium conjungens* (Burgenland; Plate 1, Fig. F, G) is similar to the early form of *L. penslii* (TCR). The latter is generally larger, and with different proportions in being higher, and having a wider posterior gape (Plate 1, Fig. F', G'). The umbo above the hinge is also higher. LUEGER (1980) reported the common occurrence of *L. conjungens* and *L. penslii* from Großhöflein, Burgenland. Indeed, his "*L. penslii*" specimens are unusually large for *L. conjungens*, but they

#### Plate 1

Ancestor – descendant pairs in bivalves from the western (Burgenland) and eastern (TCR) margins of the Kisalföld Basin.

Fig.-A: *Unio atavus* HÖRNES, Großhöflein.

Fig.-A': *Unio mihanovici* BRUSINA, Dáka.

Fig.-B, C, D: *Congeria gitneri* BRUSINA, B, C: Stegersbach, D: Großhöflein.

Fig.-B', C', D': *Dreissena auricularis* (FUCHS), B': Lázi, C': Szák, D': Neszmély.

Fig.-E: *Lymnocardium schedelianum* (PARTSCH) (authorship and taxonomic status needs revision), Oggau.

Fig.-E': *Lymnocardium variocostatum* VITÁLIS, Dáka.

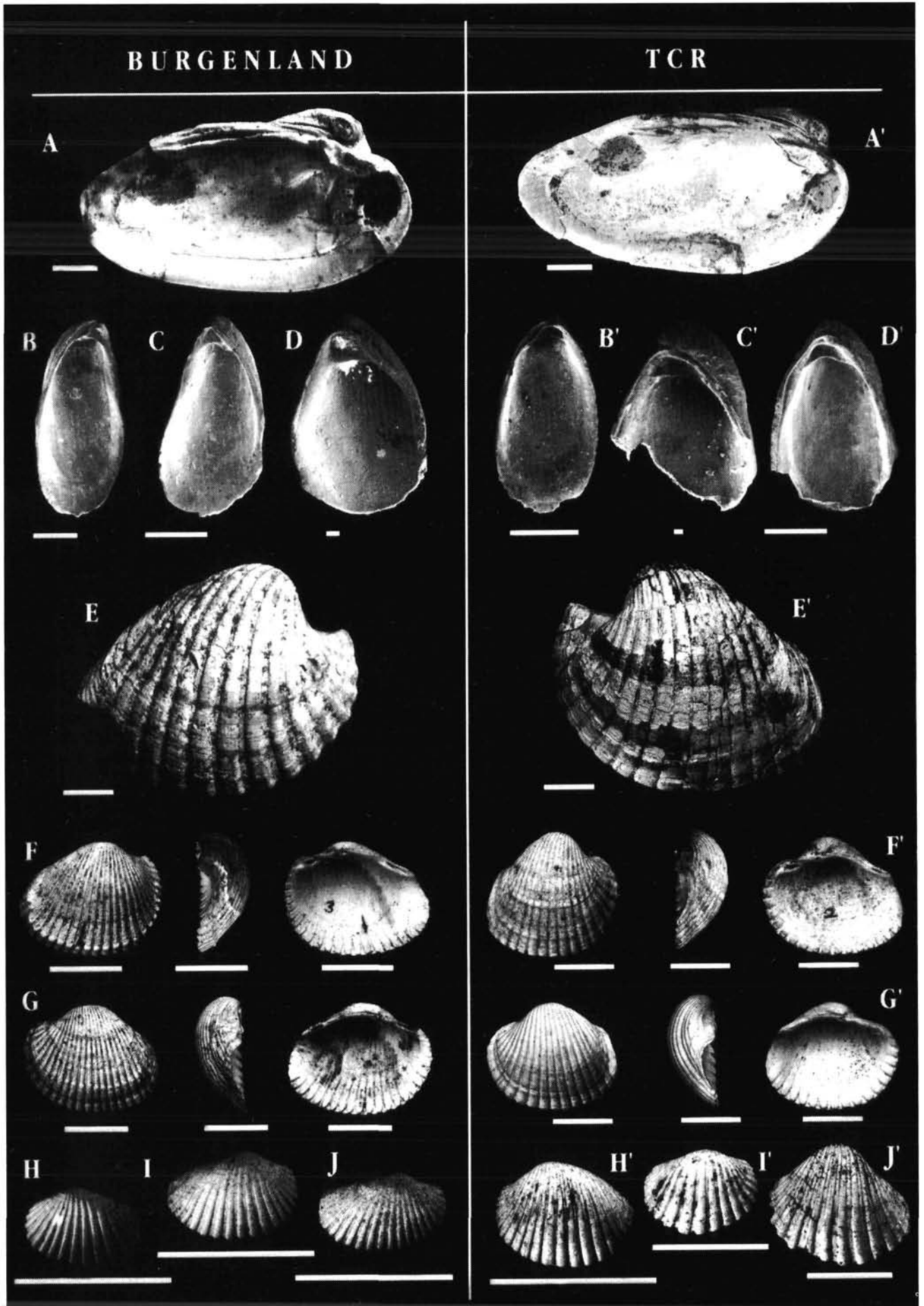
Fig.-F, G: *Lymnocardium conjungens* (HÖRNES), Stegersbach.

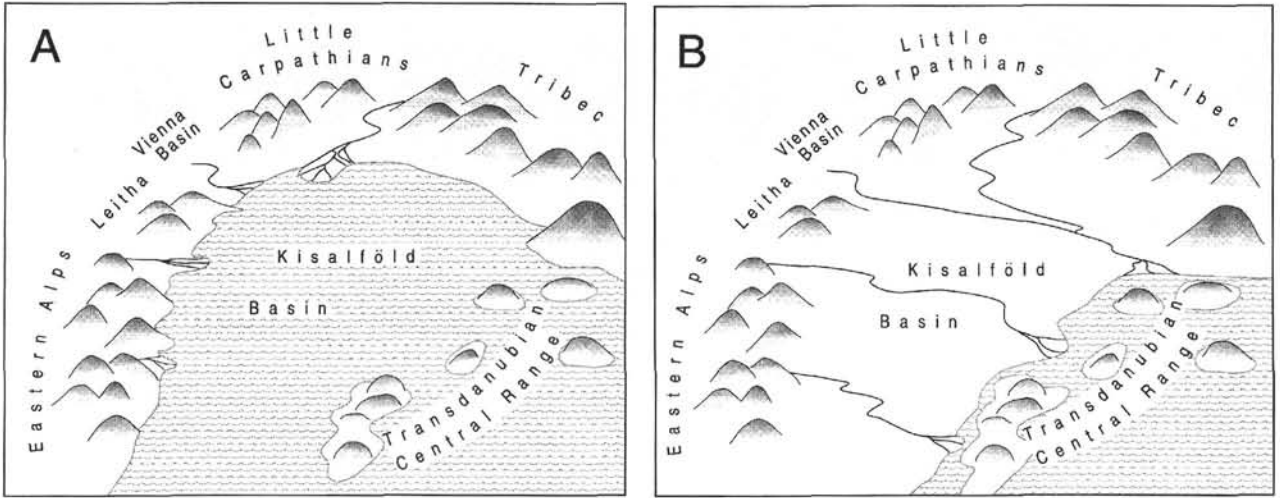
Fig.-F', G': *Lymnocardium penslii* (FUCHS), F': Ukk, G': Túskevár.

Fig.-H, I, J: *Lymnocardium edlaueri* PAPP, H: Pezinok, I, J: Stegersbach.

Fig.-H', I', J': *Lymnocardium ponticum* HALAVÁTS, H': Pápa, I': Nyárád, J': Dáka.

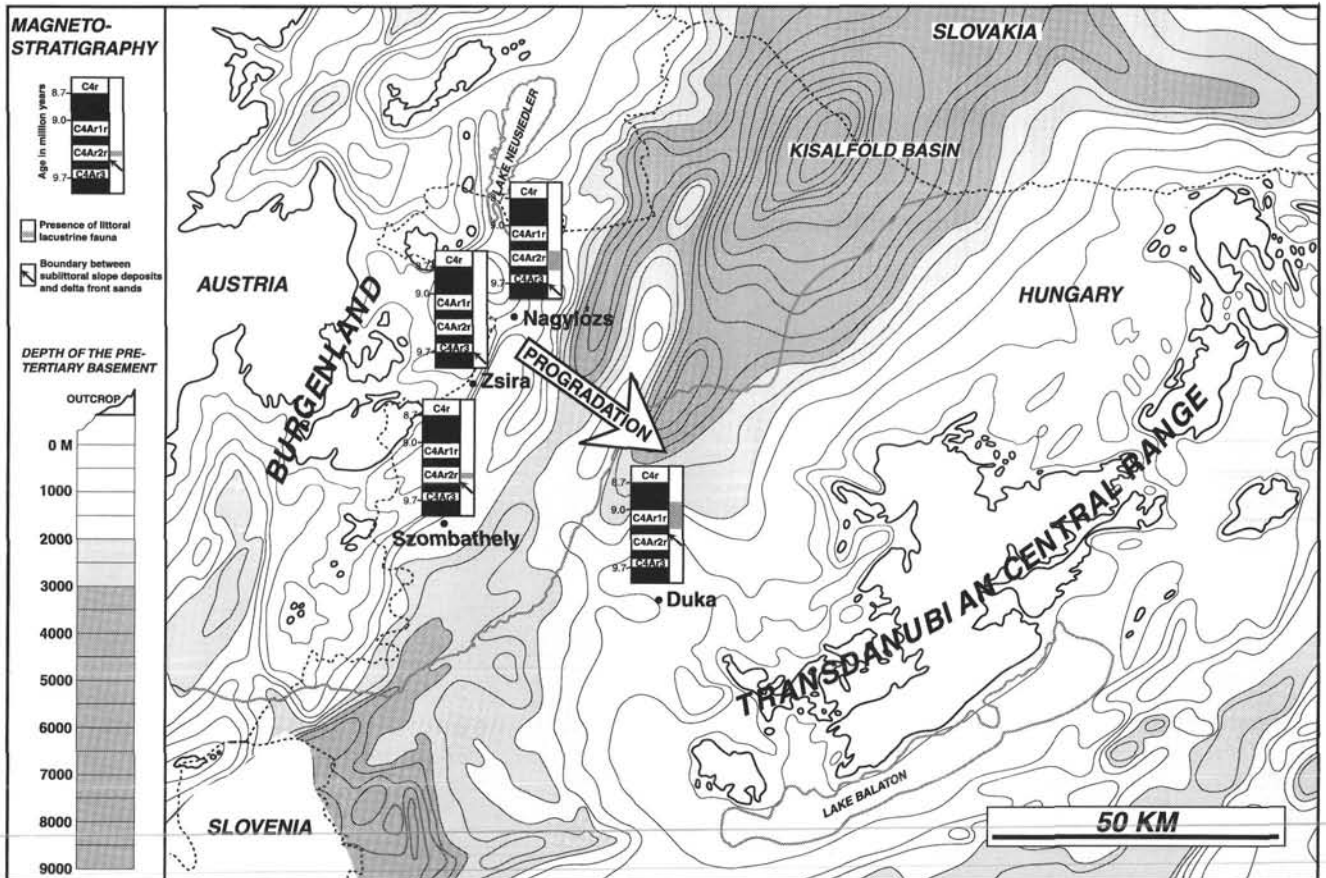
Scale bars indicate 1 cm, except Fig.-B, C, B', D', where it is 1 mm, and Fig.-D and C', where it is 100 µm.





Text-Fig. 3.

Generalized cartoon representing the paleogeographic evolution of the Kisalföld Basin between the time of the "Burgenland fauna" (*Lymnocardium conjungens* Biochron; Fig. A) and the time of the "TCR fauna" (*Lymnocardium ponticum* Biochron; Fig. B).



Text-Fig. 4.

Assessment of the age of the Burgenland and TCR faunas by means of magnetostratigraphy. Along the western margin of the Kisalföld Basin, the boundary between fine-grained, sublittoral slope deposits and delta front sands were correlated to the top of C5n (Nagylozs-1, Zsira-1) and to the base of C4Ar2r (Szombathely-II). These correspond to ca. 9.7 and 9.5 Ma, respectively, according to BERGGREN et al. (1995). The littoral lacustrine fauna appears both in the Nagylozs-1 and Szombathely-II boreholes in C4Ar2r. At the eastern margin of the basin, in the Duka-II borehole, the base of the delta front deposits correlates to C4Ar1n (ca. 9.3 Ma), and the littoral fauna occurs from C4Ar1n to C4n. (Correlation of the actual polarity record of each borehole to the standard scale was carried out by Lantos, using the long normal C5n as tie-point in the western boreholes, and utilizing seismic profiles to connect the Duka section with Szombathely; see also MAGYAR et al., 1999.)

are injured and fragmentary thus cannot be subject to morphometric analysis.

*Lymnocardium edlaueri* is a common, but small bivalve in Burgenland (Plate 1, Fig. H, I, J) that is very similar to *L. ponticum* (TCR; Plate 1, Fig. H', I', J'). *L. edlaueri* tends to be more elongate antero-posteriorly; *L. ponticum* usually grows bigger, and in larger specimens the umbo is high above the hinge.

In two additional cases, the significance of the morphological differences between the Burgenland and the TCR specimens is unclear because we have so few specimens from the TCR. *Lymnocardium tucani* from Burgenland usually has more than 30 ribs. The TCR specimens, however, have only 23 to 26. Apart from this difference, the shells from the two regions look very much alike. The only known full TCR specimen of "*Didacna*" *deserta* significantly differs from the Burgenland specimens in having a longer posterior margin, and consequently, a smaller angle between the posterior and posterodorsal margins. The ventralmost point of the valve is in the posterior part, instead of being in central position (see MILAN et al., 1974).

#### 4. Discussion

The only alternative to an evolutionary explanation for the morphological differences observed between Burgenland and TCR bivalves is that these differences reflect geographic variation. This hypothesis would require the presence of a paleogeographic barrier between the western and eastern margins of the Kisalföld Basin, such as, for instance, a profound lacustrine zone in the axis of the basin. Seismic evidence, however, indicates that although the Burgenland outcrops and the TCR outcrops are presently situated on the opposite margins of the Kisalföld Basin, historically they represent the same (NW) shoreline of Lake Pannon at two different times in the evolution of the lake (Text-Fig. 3).

The morphological and temporal differences between the Burgenland fauna and the TCR fauna provide the basis for the distinction of the *Lymnocardium conjungens* Zone (Burgenland) and *L. ponticum* Zone (TCR). Our paleogeographic model implies that between the Burgenland and TCR faunas there must be a continuous littoral fossil record buried beneath Pliocene and Quaternary sediments in the central part of the Kisalföld Basin.

Our progradational model has further predictions/consequences. It implies that 1) the youngest lacustrine fauna in the Vienna Basin is older than the Burgenland fauna; and 2) the littoral fauna southeast of the TCR is younger than the TCR fauna. The second prediction is met by the presence of the *Lymnocardium decorum* Zone (with Tihany- and Rădmănești-type faunas; see MÜLLER, 1990 and MARINESCU, 1990) south and east of the TCR. Data relevant to the first prediction are more ambiguous. Austrian, Czech, and Slovak stratigraphers traditionally assign the uppermost lacustrine fauna of the Vienna Basin as well as that of Burgenland to Zones D and E of PAPP (1951), and do not recognize an age difference between the faunas of the Vienna Basin and Burgenland (see, for instance, PAPP, 1951; SAUERZOPF, 1952; LUEGER, 1980; JIŘIČEK, 1985; FORDINÁL, 1997). At this time, we cannot provide convincing paleontological evidence that the Vienna Basin littoral faunas are older than those from Burgenland, however we know of no evidence that argues against this interpretation.

According to this progradational model, the TCR lacustrine fauna cannot occur in Burgenland, because the latter area was transformed into alluvial plains by the time the TCR fauna

evolved. The Burgenland fauna, however, could live in the TCR region, in littoral zones around islands. Indeed, we know one such occurrence from the southernmost part of the TCR. The Kálla Gravel and Sand Formation (JÁMBOR, 1980) contains typical "Burgenland" molluscs: *Unio atavus*, *Congeria* sp. ex group *C. subglobosa-panicci*, *Lymnocardium* cf. *soproniense* (or *schedelianum*?), and *Melanopsis fossilis* (see MAGYAR, 1988).

There are no radioisotopic ages from the Kisalföld Basin to determine the age of the respective faunas. We must rely on magnetostratigraphic analyses from the Nagylózs-1, Zsira-1, Szombathely-II, and Duka-II boreholes. Interpretation of these polarity profiles by LANTOS (in LANTOS & ELSTON, 1995 and pers. comm.) is anchored to the long-lasting Chron 5 normal. In the Nagylózs and Szombathely boreholes, which lie close to the western margin of the Kisalföld Basin, the interval with the littoral lacustrine fauna was correlated to C4Ar2r (MAGYAR et al., 1999; cf. KÖRPÁS-HÓDI, 1992 and LANTOS & ELSTON, 1995). On the opposite (eastern) side of the basin, in the Duka-II borehole, however, the littoral fauna correlates to C4Ar1r (MAGYAR et al., 1999; identification of molluscs in all three boreholes was carried out by KÖRPÁS-HÓDI; Text-Fig. 4). If we accept this correlation, then the age of the Burgenland fauna is somewhat older than 9.5 mys (because the Burgenland outcrops lie westward from these boreholes), whereas the age of the TCR fauna is slightly younger than 9.3 mys. The age difference between the western and eastern littoral faunas of the Kisalföld Basin is thus on the order of 0.5 million years.

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## APPENDIX

In the Appendix we give known occurrences of characteristic bivalves of sandy, littoral deposits of Lake Pannon from Burgenland and the Transdanubian Central Range, respectively. Species names given by the collector or author of paper are given in brackets where they do not correspond to our identification. Key to the collections is given in the Materials and methods section. Materials from outcrops in the vicinity of Müllendorf and Großhöflein (Föllig or Fölick) are united under the name "Großhöflein".

Because most of the MÁFI collection was obtained before 1920 by field geologists of the Royal Hungarian Geological Institute, this material is originally labelled and registered according to old Hungarian settlement names. In order to facilitate identification, we give these names in parentheses after their Slovak and German counterparts at the end of the Appendix.

### The Burgenland fauna

<i>Unio atavus</i>	
Großhöflein:	LUEGER, 1980 [ <i>Psilunio atavus</i> ]; JPL; FS; MÁFI
Stegersbach:	SAUERZOPF, 1952 [ <i>Psilunio stegersbachensis</i> ]; DHG
Olbendorf:	SAUERZOPF, 1952 [ <i>Psilunio stegersbachensis</i> ]



Litzelsdorf: FS [*Psilunio litzelsdorfensis*]  
 Oberdorf: SAUERZOPF, 1952 [*Psilunio stegersbachensis*]; FS; MÁFI  
 Pezinok: MÁFI

*Congerina spathulata*

Großhöflein: LUEGER, 1980; JPL; FS  
 Stegersbach: DHG; FS  
 Oberdorf: FS

*Congerina unguicaprae*

Pezinok: FORDINÁL, 1997; MM  
 Sopron: ANDRUSOV, 1897 [*Congerina hoemesi*]; PAPP, 1953, 1985  
 [Congerina hoemesi]; MÁFI

*Congerina pancici*

Großhöflein: LUEGER, 1980; JPL; FS  
 Stegersbach: SAUERZOPF, 1952 [*Congerina pancici longiconcha*]; PAPP, 1953, 1985; FS; DHG; MÁFI; BL  
 Steinbach: MÁFI  
 Siegendorf: MÁFI; FS  
 St. Margarethen im Burgenland: MÁFI

*Congerina praebalatonica*

Großhöflein: LUEGER, 1980 [*Congerina balatonica*]; JPL; FS  
 Stegersbach: SAUERZOPF, 1952 [*Congerina spathulata praebalatonica*];  
 PAPP, 1953 [*Congerina spathulata praebalatonica*]  
 Litzelsdorf: SAUERZOPF, 1952 [*Congerina spathulata praebalatonica*]

*Congerina doderleini*

Stegersbach: PAPP, 1953, 1985; DHG  
 Pezinok: FORDINÁL, 1991, 1997  
 St. Margarethen im Burgenland: FS

*Congerina gitneri*

Großhöflein: LUEGER, 1980 [*Dreissena minima*]; DHG  
 Stegersbach: DHG

*Dreissena bipartita*

Pezinok: FORDINÁL, 1997

*Lymnocardium schedelianum*

Großhöflein: LUEGER, 1980; JPL; FS  
 Bratislava: FORDINÁL, 1995  
 Stegersbach: DHG; FS  
 St. Margarethen im Burgenland: MÁFI; FS  
 Zillingtal: MÁFI  
 Oggau: FS

*Lymnocardium brunense*

Großhöflein: JPL  
 Sopron: TTM  
 St. Margarethen im Burgenland: MÁFI; FS  
 Bratislava: FORDINÁL, 1995

*Lymnocardium conjungens*

Großhöflein: LUEGER, 1980; JPL; MÁFI  
 Stegersbach: FS; DHG; MÁFI; TTM  
 Steinbach: MÁFI  
 Sopron: TTM  
 Gols: JPL  
 St. Margarethen im Burgenland: MÁFI; FS  
 Pezinok: FORDINÁL, 1997; MÁFI; MM  
 Siegendorf: NHMW  
 Fertőrákos: TTM  
 Bratislava: FORDINÁL, 1995  
 Purbach am Neusiedlersee: FS  
 Oggau: FS

*Lymnocardium hantkeni*

Stegersbach: NHMW; FS [*Lymnocardium stegersbachensis* n. sp.]  
 Großhöflein: LUEGER, 1980; JPL

*Lymnocardium edlaueri*

Großhöflein: JPL  
 Stegersbach: FS; DHG  
 Pezinok: MÁFI [*Lymnocardium vicinum*]; MM  
 St. Margarethen im Burgenland: FS  
 Gols: JPL

*Lymnocardium tucani*

Großhöflein: LUEGER, 1980; JPL; DHG; MÁFI; FS  
 Stegersbach: FS; DHG; MÁFI  
 (?) Sopron: TTM

*Lymnocardium subdiprosopum*

Großhöflein: LUEGER, 1980 [*L. diprosopum*]; JPL; FS

*"Lymnocardium" carnuntinum*

Großhöflein: DHG  
 Steinbrunn: MÁFI [*Lymnocardium pseudosuessi*]  
 Zillingtal: MÁFI

*"Lymnocardium" danicici*

Großhöflein: LUEGER, 1980; JPL; MÁFI; DHG; FS  
 Sopron: TTM [*Lymnocardium galeatum*]

*"Lymnocardium" stojadinovici*

Unterschützen: MÁFI  
 Stegersbach: MÁFI

*"Lymnocardium" stoosi, late form*

St. Margarethen im Burgenland: MÁFI  
 Bratislava: FORDINÁL, 1995 [*Pseudocatillus simplex*]  
 Stegersbach: MÁFI, DHG  
 Großhöflein: LUEGER, 1980 [*Pseudocatillus simplex*]; DHG; FS  
 Siegendorf: FS  
 Burgau: FS

*Caladacna steindachneri*

Großhöflein: JPL  
 Sopron: TTM  
 Bratislava: FORDINÁL, 1995 [*Caladacna ornata bisepta*]

*Euxinocardium schreteri*

Stegersbach: FS; DHG; MÁFI

*"Didacna" deserta*

Siegedorf: MÁFI  
 Großhöflein: LUEGER, 1980; JPL  
 Stegersbach: STOLICZKA, 1862 [*Cardium desertum*]; PAPP, 1953,  
 1985; FS; DHG; MÁFI

Steinbach: MÁFI

Sopron: TTM  
 Siegendorf: JPL  
 Bruck an der Leitha: MÁFI  
 Bratislava: FORDINÁL, 1995  
 St. Margarethen im Burgenland: FS

*"Monodacna" viennensis*

Großhöflein: JPL  
 Stegersbach: MÁFI

*Parvidacna petkovic*

Stegersbach: FS [*Parvidacna loerenthey*]; PAPP, 1953, 1985; NHMW  
 Bratislava: FORDINÁL, 1993  
 Großhöflein: LUEGER, 1980

The TCR fauna

*Unio mihanovici*

Dáka: SZILAJ et al., 1999; MM  
 Pápa: MÁFI  
 Kocs: MÁFI  
 Románd: UV  
 Ukk: MÁFI  
 Veszprémgalsa: MÁFI  
 Kerékteleki: MÁFI

*Congerina aff. simulans turgida*

Neszmély: ANDRUSOV, 1897 [*Congerina turgida*]  
 Dáka: SZILAJ et al., 1999; MM; MÁFI  
 Pápa: MÁFI  
 Ukk: MÁFI

*Congerina unguicaprae*

Kup: FUCHS, 1870 [*Congerina balatonica* var. *crassitesta*]; MÁFI  
 Mocs: KÖRÖSI-HÓDI, 1983  
 Tata: KÖRÖSI-HÓDI, 1983  
 Ch'aba: MÁFI  
 Somlóvásárhely: ANDRUSOV, 1897; MÁFI  
 Doba: MÁFI  
 Gic: MÁFI  
 Kopolcs: MÁFI  
 Neszmély: MÁFI  
 Kocs: MÁFI

Kömlöd: MÁFI  
 Környe: MÁFI  
 Kisbér: MÁFI  
 Csép: MÁFI  
 Császár: MÁFI  
 Agostyán: MÁFI  
 Kerékteleki: MÁFI  
 Románd: UV; MÁFI  
 Pápa: MÁFI  
 Padragkút: MÁFI  
 Káptalantóti: MÁFI

*Dreissenomya unioides*

Lázi: BARTHA, 1963; MÁFI  
 Dáka: SZILAJ et al., 1999; MM; MÁFI  
 Szák: MM

*Dreissena auricularis*

Kup: FUCHS, 1870; MÁFI  
 Dáka: SZILAJ et al., 1999; MM; MÁFI  
 Pápa: MÁFI  
 Lázi: BARTHA, 1963; MÁFI  
 Naszály: KORPÁS-HÓDI, 1983  
 Dunaszentmiklós: KORPÁS-HÓDI, 1983  
 Szák: MM  
 Somlójenő: UV  
 Veszprémgalsa: MÁFI

*Dreissena bipartita*

Kup: ANDRUSOV, 1897; BRUSINA, 1902; HPM  
 Dáka: SZILAJ et al., 1999; MM

*Lymnocardium variocostatum*

Lázi: BARTHA, 1963; MÁFI  
 Dáka: SZILAJ et al., 1999; MM; MÁFI; TTM;  
 Kocs: VITÁLIS, 1934; MÁFI  
 Kup: MÁFI  
 Pápa: MÁFI; UV  
 Tárkány: MÁFI  
 Somlójenő: UV; MÁFI  
 Románd: UV  
 Túskevár: TTM  
 Gic: MÁFI  
 Külsővat: MÁFI  
 Veszprémgalsa: MÁFI

*Lymnocardium apertum*

Lázi: MÁFI  
 Dáka: SZILAJ et al., 1999; MM; MÁFI; TTM  
 Szák: MM  
 Dunaalmás: KORPÁS-HÓDI, 1983  
 Pápa: MÁFI  
 Veszprémgalsa: MÁFI

*Lymnocardium pensili*

Lázi: BARTHA, 1963; MÁFI  
 Dáka: SZILAJ et al., 1999; MM; MÁFI; TTM;  
 Kocs: KORPÁS-HÓDI, 1983; MÁFI  
 Szák: MM  
 Pápa: MÁFI  
 Veszprémgalsa: MÁFI  
 Ukk: MÁFI  
 Somlójenő: MÁFI; UV  
 Kup: NHMW; MÁFI  
 Románd: UV  
 Túskevár: TTM; MÁFI [*Lymnocardium banaticum*]  
 Neszmély: TTM; MÁFI  
 Dunaalmás: TTM  
 Bársonyos: MÁFI  
 Tárkány: MÁFI  
 Gic: MÁFI  
 Kapolcs: MÁFI  
 Kerékteleki: MÁFI  
 Pápakovácsi: MÁFI

*Lymnocardium hantkeni*

Kup: FUCHS, 1870; MÁFI  
 Szák: MM; MÁFI  
 Dáka: SZILAJ et al., 1999; MM

Pápa: MÁFI  
 Somlójenő: STRAUSZ, 1942  
 Túskevár: MÁFI

*Lymnocardium ponticum*

Dáka: SZILAJ et al., 1999; MM  
 Nyárad: MM  
 Naszály: KORPÁS-HÓDI, 1983 [*Lymnocardium trifkoviczi*, *L. decorum*]  
 Kocs: KORPÁS-HÓDI, 1983  
 Pápa: MÁFI  
 Kup: NHMW [*Cardium decorum*]; BRUSINA, 1902 [*Lymnocardium trifkoviczi*]; HPM

*Lymnocardium tucani*

Pápa: STRAUSZ, 1942 [*Lymnocardium banaticum* var.]  
 Lázi: MÁFI [*Lymnocardium* sp.]  
 Túskevár: MÁFI

*"Lymnocardium" priscae*

Pápa: STRAUSZ, 1942; MÁFI  
 Lázi: MÁFI  
 Túskevár: STRAUSZ, 1942  
 (?) Kocs: KORPÁS-HÓDI, 1983  
 Kup: HPM

*"Lymnocardium" cf. wurmbi*

Dáka: SZILAJ et al., 1999; MM; MÁFI  
 Pápa: TTM

*Caladacna steindachneri*

Dáka: STRAUSZ, 1942; SZILAJ et al., 1999; MM; TTM  
 Szák: MM  
 Pápa: STRAUSZ, 1942; MÁFI  
 Dunaalmás: KORPÁS-HÓDI, 1983  
 Túskevár: MÁFI

*Euxinocardium schreteri*

Dáka: SZILAJ et al., 1999; MM; MÁFI  
 Lázi: MÁFI  
 Szák: MM  
 Pápa: MÁFI  
 Somlójenő: STRAUSZ, 1942  
 Túskevár: MÁFI

*"Didacna" deserta*

Kup: MILAN et al., 1974 [*Didacna chyzeri*]; HPM  
 (?) Neszmély: MÁFI

*"Monodacna" viennensis*

Dáka: MM  
 Lázi: MÁFI

*Parvidacna* sp.

Lázi: BARTHA, 1963; MÁFI  
 Neszmély: KORPÁS-HÓDI, 1983 [*Parvidacna planicostata*]  
 Kocs: KORPÁS-HÓDI, 1983 [*Parvidacna planicostata*]  
 Dunaalmás: KORPÁS-HÓDI, 1983 [*Parvidacna planicostata*]  
 Pápa: MÁFI  
 Dáka: MM  
 Kup: HPM

**Hungarian settlement names from Austria and Slovakia in the MÁFI collection (in parenthesis)**

Bruck an der Leitha (Bruck)  
 Chľaba (Helemba)  
 Gols (Gálos)  
 Großhöflein (Nagyhöflány)  
 Litzelsdorf (Lődös)  
 Oberdorf (Órállás)  
 Olbendorf (Obér)  
 Pezinok (Bazin)  
 St. Margarethen im Burgenland (Szentmargitbánya)  
 Siegendorf (Cinfalva)  
 Stegersbach (Szentelek)  
 Steinbach (Kőpatak)  
 Steinbrunn (Büdöskút)  
 Unterschützen (Alsólövő)  
 Zillingtal (Völgfalu)

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